General

Guideline Title

ACR Appropriateness Criteria® upper extremity swelling.

Bibliographic Source(s)

Dill KE, Bennett SJ, Hanley M, Bandyk DF, Gage KL, Gerhard-Herman MD, Gornik HL, Johnson PT, Oliva IB, Ptak T, Steigner ML, Strax R, Rybicki FJ, Expert Panel on Vascular Imaging. ACR Appropriateness CriteriaÂ® upper extremity swelling [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 9 p. [67 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Desjardins B, Rybicki FJ, Kim HS, Fan CM, Flamm SD, Gerhard-Herman MD, Kalva SP, Koss SA, Mansour MA, Mohler ER III, Narra VR, Schenker MP, Tulchinsky M, Weiss C, Expert Panel on Vascular Imaging. ACR Appropriateness Criteria® suspected upper extremity deep vein thrombosis. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 7 p. [58 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Upper Extremity Swelling

Radiologic Procedure	Rating	Comments	RRL*
US duplex Doppler upper extremity	9	This procedure is standard for arm veins. Other modalities required for evaluating central veins.	O
X-ray chest	8	This procedure is a simple evaluation of lines, mediastinal contours, and cervical ribs. It is complementary to Doppler if a diagnosis other than DVT is suspected.	☢
MR venography chest without and with contrast	8	With this procedure, an asymptomatic side injection is preferred. This procedure is indicated for central veins.	O
CT venography chest without and with contrast	7	This procedure is usually appropriate when iodinated	☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative

Radiologic Procedure	Rating	contrast is contraindicated. Comments	RRL*
X-ray venography upper extremity and SVC	7	Although this is the reference standard, it is complementary and generally reserved for inconclusive noninvasive studies.	☢☢☢
CT venography chest with contrast	7	With this procedure, an asymptomatic side injection preferred. This procedure is an alternative to MR venography for central veins.	☢☢☢☢
Radionuclide venography upper extremity and chest	3	This procedure has been largely supplanted. It has limited use for central veins when CT and MR venography are both contraindicated.	☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction/Background

Upper-extremity deep venous thrombosis (UEDVT) accounts for up to 10% of all diagnosed deep venous thrombi. Although relatively rare, the incidence of UEDVT is believed to be rising at least in part due to the increased longevity of patients with chronic disease and the increased frequency of vascular catheter utilization. Thrombosis is classified according to etiology as either primary or secondary to a predisposing factor such as an indwelling catheter, trauma, or extrinsic compression. Additionally, UEDVT involving the axillary vein or any more central vessel can be further described as proximal, with distal UEDVT affecting the brachial, radial, and ulnar veins.

Secondary deep venous thrombosis (DVT) of the upper extremity is by far the most common type. Indwelling venous devices such as catheters, pacemakers, and defibrillators put patients at the highest risk of thrombus. Central venous catheters, which are difficult to place, such as those requiring multiple insertion attempts, are noted to have increased incidence of associated thrombus. Other risk factors associated with higher likelihood of UEDVT include advanced age, previous thrombophlebitis, postoperative state, hypercoagulability, heart failure, cancer, right-heart procedures, and intensive care unit admissions.

The non-O blood group as well as patients with certain abnormally elevated coagulation factors were recently demonstrated to be at increased risk of UEDVT. Although many of the same risk factors for lower-extremity DVT also increase the risk for UEDVT, research is helping to elucidate certain variables unique to thrombi in the upper extremity.

Primary UEDVT is less common and is diagnosed in about one-third of all UEDVT cases. Etiologies of primary UEDVT include thoracic outlet syndrome and effort-related thrombosis (Paget-Schroetter syndrome), and occasionally it is idiopathic.

Patients who develop UEDVT often present with symptoms of ipsilateral upper-extremity edema, pain, paresthesias and, in some instances, functional impairment. Catheter-associated thrombosis may be asymptomatic, rather manifesting as catheter dysfunction or as an incidental finding upon imaging. Superficial thrombophlebitis is associated with local pain, induration, and, often, a palpable cord. It is rarely, if ever, associated with diffuse arm swelling. Unilateral swelling indicates an obstructive process at the level of the brachiocephalic, subclavian, or axillary veins. DVT limited to the brachial veins need not be associated with swelling. Isolated jugular vein thrombosis is asymptomatic and rarely causes swelling. There may be a correlation between upper-extremity and lower-extremity DVT, and investigation of the lower extremities as well should be considered if an upper-extremity thrombus is found in the absence of a local cause.

Differentiating Causes of Upper-Extremity Swelling

The initial approach to a patient who presents with a swollen upper extremity is exclusion of venous thrombosis because anticoagulation is typically required and the underlying lesion may require a more aggressive intervention such as thrombolysis. Once the diagnosis of DVT is excluded, other etiologies may need to be evaluated. The combination of clinical features alone can be used to design a clinical prediction score for diagnosing upper-extremity DVT. Blood tests can also be used to detect the presence of DVT. Plasma levels of D-dimer, a degradation product of cross-linked fibrin that is elevated during thromboembolic events, is highly sensitive but not very specific. It is also unreliable to diagnose recurrent DVT or alternative conditions that mimic DVT, and is unable to assess the location and extent of the venous thrombus, which is critical for proper therapeutic management of DVT.

Imaging is often required for definite exclusion of DVT and to document its location and extent. Although contrast x-ray venography is considered

the reference standard for evaluating possible UEDVT, and it offers the potential for coincident initiation of therapy, noninvasive imaging is frequently the initial step. The most commonly employed noninvasive imaging includes ultrasound (US), magnetic resonance imaging (MRI), and computed tomography (CT). Other techniques, such as photoplethysmography, lymphoscintigraphy, and fluorine-18-2-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET)/CT have been discussed in the literature as part of the workup for upper-extremity swelling, particularly when lymphedema is a potential cause.

Chest Radiography

Because of the broad differential diagnoses of upper-extremity swelling, a chest radiograph may identify a mass lesion responsible for central venous obstruction or help confirm the presence and location of wires, catheters, or a retained wire or catheter fragment. Rare osseous entities that might be associated with extrinsic compression syndromes, such as a cervical rib, would also be detected.

Radionuclide Imaging

Radionuclide studies can confirm upper-extremity venous obstruction, and have been considered the reference standard for diagnosis of extremity lymphedema. The diagnostic criteria for venous obstruction include failure to visualize one or more of the main venous segments (axillary, subclavian, brachiocephalic, or superior vena cava [SVC]) and visualization of collateral venous channels. This test is typically not able to differentiate intrinsic venous thrombosis from extrinsic compression. For edema related to lymphatic obstruction, the presence of certain features such as dermal backflow and lymph node asymmetry can increase the diagnostic specificity after intradermal injection. Some authors have indicated that differentiating between primary lymphedema and secondary lymphedema, such as that due to venous obstruction, may be limited when using intradermal lymphangiography alone. Furthermore, magnetic resonance (MR) lymphangiography is currently being evaluated as a radiation-free alternative to conventional, radionuclide lymphoscintigraphy and may play a larger role in the future.

X-ray Venography

This is the "reference standard" examination for evaluating the upper-extremity veins. The examination carries the risks associated with the injection of an iodinated contrast agent. Patient tolerance has been improved, and the risks of adverse events have been reduced with low-osmolar contrast agents. Direct evidence of venous thrombus is based on the visualization of a filling defect in the vein. Less specific findings for venous thrombus include abrupt contrast cut-off, absence of contrast filling, or the presence of collateral channels. Venography can identify fixed venous stenoses and, with upper-extremity maneuvers (abduction), can identify extrinsic venous compression. The utility of these maneuvers has also been described with US. Asymptomatic or minimally symptomatic venous compression with arm abduction should be treated with caution, as this finding can be made in a substantial number of normal individuals. Venography can also identify recurrent acute venous thrombus in patients with prior history of venous thrombus. Despite its widespread acceptance as a reference standard based on extension of evidence associated with lower-extremity DVT, there are few clinical trials supporting its use.

Venous Ultrasound

Duplex US is a relatively inexpensive test that can exclude DVT and help identify a proximal venous obstruction. It is noninvasive, can be performed at the patient's bedside, and can be used for serial evaluation. Diagnostic criteria for direct evidence of thrombus, as in the lower extremity, include loss of compression of imaged vein walls when pressure is applied on the skin during real-time imaging, and visualization of echogenic material in the vein. Indirect evidence of thrombus includes altered blood flow patterns. Loss of compressibility is consistent with acute DVT but can also occur in the presence of chronic venous thrombosis. US is most useful in evaluation of veins peripheral to the subclavian, such as the jugular, axillary, basilic, cephalic, and brachial veins. Compression cannot be used to evaluate subclavian or more central veins, as bony structures prevent visualization and/or compression of the vessel lumen.

A full examination also includes evaluation of the Doppler velocity profiles obtained from blood in the major veins and color-flow Doppler imaging. Dampening of cardiac pulsatility or respiratory variation waveforms on Doppler examination are reliable indicators of central venous obstruction. In addition, respiratory maneuvers such as rapid inspiration or "sniffing" should normally cause the walls of the subclavian veins to collapse due to rapid venous emptying. Impairment of this collapse may indicate a central obstructive process. However, a central thrombus will cause the same alterations in blood flow as a mass encasing or compressing the central (SVC, brachiocephalic) veins or a benign stricture. Color flow imaging can be used to image the presence or absence of flow within the vein and is useful in evaluating venous segments where compression maneuvers cannot be applied (e.g., to the central subclavian vein), although a study has suggested that if *only* blood flow abnormalities are seen, conventional venography may be necessary.

Gray-scale imaging can be used to identify echogenic thrombus. However, acute hypoechoic thrombi may be missed using gray-scale imaging alone. Adjunctive use of color flow images can help in confirming the presence or absence of hypoechoic thrombus, and can also help determine if a clot is obstructive or partially obstructive. Correlative studies between US and venography show diagnostic sensitivities and specificities above 80%.

Magnetic Resonance Imaging

Approaches to venous imaging using MRI include black-blood and flow-based or contrast-enhanced bright-blood techniques. Black-blood techniques include conventional T1 or T2 spin-echo or fast spin-echo imaging. However, the black-blood effect on routine spin-echo imaging may not be consistent, and newer double inversion-recovery techniques provide more reliable black-blood imaging. Using black-blood imaging, the presence of thrombus is inferred from focal high signal, often with venous enlargement, but it must be differentiated from a variety of flow artifacts. The high signal in thrombus on T1 imaging decreases after 6 months, and the technique is less useful for chronic thrombus.

Flow-based bright-blood MR venography (MRV) techniques include time-of-flight (TOF) and phase contrast. For venous imaging, TOF is limited to a two-dimensional (2-D) implementation due to signal saturation of slow flow. Since vessels with primarily in-plane flow are more difficult to image due to saturation, 2-D TOF is often useful in the axial plane to image flow in the jugular veins, right brachiocephalic vein, and SVC which are oriented primarily in the superior-inferior direction. TOF venography can be used to image the subclavian vein, but more time-consuming sagittal acquisitions are preferred due to the direction of flow, and breathing artifacts may also impair imaging quality. Phase contrast has not been widely used for upper-extremity venography due to the slow flows that must be detected. Recently, balanced gradient echo (steady-state free precession), and cardiac-gated three-dimensional (3-D) fast spin-echo techniques have been implemented for noncontrast MR vessel imaging. Although these techniques have not been evaluated for chest venography, they appear promising. Balanced gradient-echo images alone are insensitive for detecting central venous thrombus, partly because of the variable signal intensity of thrombus over time, as acute thrombus is relatively isointense to blood with such sequence. Cardiac-gated 3-D fast spin-echo techniques can help differentiate transient flow artifacts from true filling defects that persist over the cardiac cycle.

Contrast-enhanced MRV can also be used by implementing 2-D or 3-D T1 gradient-echo images with fat saturation after administration of a single or a double dose of MR contrast. Typically, venous phase images are obtained after an MR arteriogram by simply allowing enough time delay for the contrast bolus to enter the venous or equilibrium phase. Fibrin-specific MR contrast agents can further enhance all thrombi and may even detect thrombi not readily visible in precontrast imaging. The use of time-resolved (TR) imaging techniques allows visualization of flow and has been shown to reduce both the contrast volume and acquisition time while improving specificity when used as an adjunct to conventional MR sequences. It has found use in protocols for whole-body venography and was shown to produce images of comparable diagnostic quality but lower specificity compared to conventional MRV in the assessment of central thoracic veins. Certain MR protocols, such as TR-MRI, might eventually be used as a fast, noninvasive, and relatively safe imaging tool for screening and serial follow-up of patients with poor renal function, but further study is required.

The advantages of MRV are primarily for central venous evaluation, as the central veins cannot be imaged directly by US. For imaging the distal upper extremity vessels, US or even x-ray venography is preferred. MRV of the arm is rendered more difficult by its placement at the periphery of the magnetic field or the requirement to maintain the arm motionless over the head. MRI is capable of producing very high-resolution images of the soft tissues, so it can help identify mimics of DVT and potential sources of extrinsic venous compression. To exploit this diagnostic potential, MRV protocols often include standard MRI sequences such as T1-weighted (spin echo, gradient return echo) and T2-weighted (fast spin echo) sequences to assess the anatomy surrounding the vessels. Studies so far specifically comparing MRV to venography have been mixed, with some work showing MRV to be as effective as venography but other work showing its limitations. A recent meta-analysis found MRV to have both a high sensitivity and a high specificity, although the study did not focus on the upper extremities.

Computed Tomography

CT can be used to determine the presence of centrally located thrombi or stenoses within the jugular veins, the brachiocephalic veins, and the SVC. The presence of an extrinsic process causing venous obstruction of the venous channels can also be demonstrated. CT is the main imaging modality for staging neoplastic involvement in the mediastinum and axillae, which can include vascular invasion or compression. Perivascular inflammatory changes around chronic thrombi can also be detected by CT. Delayed imaging at 90 to 120 seconds can permit evaluation of the central veins. No large series of studies have looked at the diagnostic accuracy of this technique for diagnosing upper-extremity venous thrombosis, although extensive experience is accumulating with lower-extremity venous thrombosis. One small series showed that the performance of CT venography is similar to that of conventional venography in the thoracic and upper-extremity veins, and that it evaluates the central extent of obstruction more effectively. Although CT is considered noninvasive, it exposes the patient to radiation.

Summary of Recommendations

- Despite the availability of noninvasive imaging techniques, contrast venography remains the best reference standard diagnostic test for suspected upper-extremity acute venous thrombosis.
- Contrast venography may be needed whenever other noninvasive strategies fail to adequately image the upper-extremity veins. In situations such as acute UEDVT, where the likelihood of percutaneous thrombectomy or thrombolysis is high, it is sensible to proceed directly to venography.

- Duplex, color flow, and compression US have also established a clear role in evaluation of the more peripheral veins that are accessible to sonography.
- Gadolinium contrast-enhanced MRI is routinely used to evaluate the status of the central veins. Unfortunately, despite its widespread clinical use, there are few validation studies of this technique compared to the extensive literature on contrast venography. The recognition of gadolinium as a cause of nephrogenic systemic fibrosis has increased interest in noncontrast MRV, but validation of these techniques remains an issue.
- Delayed CT venography can often be used to confirm or exclude more central venous thrombi. As in the case of MRV, there are few correlative studies justifying this approach.

Abbreviations

- CT, computed tomography
- DVT, deep venous thrombosis
- MR, magnetic resonance
- SVC, superior vena cava
- US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Upper-extremity swelling

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Family Practice

Hematology

Internal Medicine

Radiology

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of the appropriateness of various imaging modalities for the evaluation of patients with upper extremity swelling

Target Population

Patients with upper extremity swelling

Interventions and Practices Considered

1. Ultrasound (US), duplex Doppler, upper extremity
2. X-ray
    - Chest
    - Venography, upper extremity and superior vena cava (SVC)
3. Magnetic resonance (MR) venography, chest
    - Without and with contrast
    - Without contrast
4. Computed tomographic (CT) venography, chest, with contrast
5. Radionuclide venography, upper extremity and chest

Major Outcomes Considered

- Utility of radiologic examinations in differential diagnosis
- Sensitivity, specificity, and reliability of radiologic examinations in diagnosis

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Summary

Of the 58 citations in the original bibliography, 51 were retained in the final document. Articles were removed from the original bibliography if they were more than 10 years old and did not contribute to the evidence or they were no longer cited in the revised narrative text.

Two new literature searches were conducted in July 2013 and January 2014 to identify additional evidence published since the *ACR Appropriateness Criteria® Upper Extremity Swelling* topic was finalized. Using the search strategies described in the literature search companion (see the "Availability of Companion Documents" field), 152 articles were found. Seven articles were added to the bibliography. One hundred forty-five articles were not used due to either poor study design, the articles were not relevant or generalizable to the topic, the results were unclear, misinterpreted, or biased, or the articles were already cited in the original bibliography.

The author added 9 citations from bibliographies, Web sites, or books that were not found in the new literature search.

See also the American College of Radiology (ACR) Appropriateness Criteria® literature search process document (see the "Availability of Companion Documents" field) for further information.

Number of Source Documents

Of the 58 citations in the original bibliography, 51 were retained in the final document. The new literature search conducted in July 2013 and January 2014 identified seven articles that were added to the bibliography. The author added 9 citations from bibliographies, Web sites, or books that were not found in the new literature search.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Study Quality Category Definitions

Category 1 - The study is well-designed and accounts for common biases.

Category 2 - The study is moderately well-designed and accounts for most common biases.

Category 3 - There are important study design limitations.

Category 4 - The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:

a. The study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description).
b. The study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence.
c. The study is an expert opinion or consensus document.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author assesses the literature then drafts or revises the narrative summarizing the evidence found in the literature. American College of Radiology (ACR) staff drafts an evidence table based on the analysis of the selected literature. These tables rate the study quality for each article included in the narrative.

The expert panel reviews the narrative, evidence table and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the variant table(s). Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development documents (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Rating Appropriateness

The American College of Radiology (ACR) Appropriateness Criteria (AC) methodology is based on the RAND Appropriateness Method. The appropriateness ratings for each of the procedures or treatments included in the AC topics are determined using a modified Delphi method. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. The expert panel members review the evidence presented and assess the risks or harms of doing the procedure balanced with the benefits of performing the procedure. The direct or indirect costs of a procedure are not considered as a risk or harm when determining appropriateness. When the evidence for a specific topic and variant is uncertain or incomplete, expert opinion may supplement the available evidence or may be the sole source for assessing the appropriateness.

The appropriateness is represented on an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "usually not appropriate" where the harms of doing the procedure outweigh the benefits; and 7, 8, or 9 are in the category "usually appropriate" where the benefits of doing a procedure outweigh the harms or risks. The middle category, designated "may be appropriate", is represented by 4, 5, or 6 on the scale. The middle category is when the risks and benefits are equivocal or unclear, the dispersion of the individual ratings from the group median rating is too large (i.e., disagreement), the evidence is contradictory or unclear, or there are special circumstances or subpopulations which could influence the risks or benefits that are embedded in the variant.

The ratings assigned by each panel member are presented in a table displaying the frequency distribution of the ratings without identifying which members provided any particular rating. To determine the panel's recommendation, the rating category that contains the median group rating without disagreement is selected. This may be determined after either the first or second rating round. If there is disagreement after the second rating round, the recommendation is "May be appropriate."

This modified Delphi method enables each panelist to articulate his or her individual interpretations of the evidence or expert opinion without excessive influence from fellow panelists in a simple, standardized and economical process. For additional information on the ratings process see the Rating Round Information document on the ACR Web site.

Additional methodology documents, including a more detailed explanation of the complete topic development process and all ACR AC topics can be found on the ACR Web site (see also the "Availability of Companion Documents" field).

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Summary of Evidence

Of the 67 references cited in the *ACR Appropriateness Criteria® Upper Extremity Swelling* document, 1 is categorized as a therapeutic reference. Additionally, 66 references are categorized as diagnostic references including 4 well-designed studies, 7 good quality studies, and 15 quality studies that may have design limitations. There are 41 references that may not be useful as primary evidence.

While there are references that report on studies with design limitations, 11 well-designed or good quality studies provide good evidence.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of patients with upper extremity swelling

Potential Harms

- X-ray venography is the "reference standard" examination for evaluating the upper-extremity veins. The examination carries the risks associated with the injection of an iodinated contrast agent. Patient tolerance has been improved, and the risks of adverse events have been reduced with low-osmolar contrast agents.
- Gadolinium-based contrast is a cause of nephrogenic systemic fibrosis.

Relative Radiation Level

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Dill KE, Bennett SJ, Hanley M, Bandyk DF, Gage KL, Gerhard-Herman MD, Gornik HL, Johnson PT, Oliva IB, Ptak T, Steigner ML, Strax R, Rybicki FJ, Expert Panel on Vascular Imaging. ACR Appropriateness CriteriaÂ® upper extremity swelling [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 9 p. [67 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

1995 (revised 2014)

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Vascular Imaging

Composition of Group That Authored the Guideline

Panel Members: Karin E. Dill, MD (*Principal Author and Panel Chair*); Shelby J. Bennett, MD (*Research Author*); Michael Hanley, MD (*Panel Vice-chair*); Dennis F. Bandyk, MD; Kenneth L. Gage, MD, PhD; Marie D. Gerhard-Herman, MD; Heather L. Gornik, MD; Pamela T. Johnson, MD; Isabel B. Oliva, MD; Thomas Ptak, MD, PhD; Michael L. Steigner, MD; Richard Strax, MD; Frank J. Rybicki, MD, PhD (*Specialty Chair*)

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Desjardins B, Rybicki FJ, Kim HS, Fan CM, Flamm SD, Gerhard-Herman MD, Kalva SP, Koss SA, Mansour MA, Mohler ER III, Narra VR, Schenker MP, Tulchinsky M, Weiss C, Expert Panel on Vascular Imaging. ACR Appropriateness Criteria® suspected upper extremity deep vein thrombosis. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 7 p. [58 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2015 Feb. 3 p. Electronic copies: Available from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2015 Feb. 1 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2015 Feb. 3 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 2015 Feb. 2 p. Electronic copies:

Available from the ACR Web site .

- ACR Appropriateness Criteria® suspected upper extremity deep vein thrombosis. Evidence table. Reston (VA): American College of Radiology; 2014. 23 p. Electronic copies: Available from the ACR Web site .
- ACR Appropriateness Criteria® suspected upper extremity deep vein thrombosis. Literature search. Reston (VA): American College of Radiology; 2014. 2 p. Electronic copies: Available from the ACR Web site .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI on April 3, 2006. This summary was updated by ECRI Institute on May 17, 2007 following the U.S. Food and Drug Administration (FDA) advisory on Gadolinium-based contrast agents. This summary was updated by ECRI Institute on June 20, 2007 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents. This summary was updated by ECRI Institute on June 8, 2010. This summary was updated by ECRI Institute on January 13, 2011 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents. This summary was updated by ECRI Institute on March 9, 2012. This summary was updated by ECRI Institute on July 29, 2015.

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